U.S. DISTRICT COURT

WESTERN DISTRICT OF WASHINGTON

JACOB BEATY and JESSICA BEATY, on behalf of themselves and all others similarly situated, Plaintiffs, vs. FORD MOTOR COMPANY, Defendant.	Case No. 3:17-cv-05201 RBL

REPORT OF THOMAS READ

February 22, 2019

Report

I, Thomas Read, declare as follows:

I. INTRODUCTION

1. Read Consulting has been asked by counsel for Plaintiffs to evaluate the Ford vehicles with panoramic sunroofs (PSR) (collectively, the "Subject Vehicles") in this litigation, to assist in explaining technical details that may be relevant in the case, and to consider whether there is evidence of a defect.

2. As set forth in detail below, based on my knowledge, skill, and experience with glass and in glass failure analysis, along with my assessment of the design and performance of PSRs, and my review of relevant documents in this case, I conclude that the panoramic sunroofs in the Subject Vehicles have substantially common, defective design features, including their size, thickness, curvature, connection to the vehicles' unibody frames, and use of ceramic paint or frit. In particular, the panoramic sunroofs contain large, thin, curved, and weakened thermally tempered glass that cannot withstand the applied tensile stresses of their natural operating environment. The inability to withstand these stresses can and will lead to a substantial likelihood of abrupt glass shattering when the vehicles are driven under normal driving conditions.

3. Accordingly, it is my considered opinion that the PSRs contain a design defect, and that this defect, which is described in this declaration, is common to the Subject Vehicles. When this defect manifests, the PSR will spontaneously break or shatter suddenly and without any warning to the driver or any occupants.

4. I reserve the right to supplement this declaration as more information becomes available.

II. QUALIFICATIONS AND METHODOLOGY

5. I have a B.S. in Metallurgy from the University of Pennsylvania, an M.S. in Materials Science from Stanford University and a Ph.D. in Materials Science and Engineering also from Stanford University. A current CV is attached as Appendix A.

6. I am a licensed manufacturing engineer in the state of California. I have over 40 years of experience involving glass, including in glass failure analysis. Presently I am a self-employed engineering consultant. I consult with numerous manufacturing companies in the area of glass fracture, and also consult with attorneys on product liability cases involving glass fractures.

7. My involvement in working with glass, tempered glass, glass failure analysis, and related subjects, began in 1972 at Corning Glass Works where I developed the finishing processes for glass computer disks and windows for the

NASA Space Shuttle. This work included preparing glass test plates, breaking them under controlled conditions and analyzing the failure of the glass. These projects also included strength testing of representative coupons (specially prepared test samples) and the follow-on failure analysis of the broken test samples. At that time, I was also involved with setting up a process for chemically tempering glass.

8. Over the span of my decades-long career studying glass, I have performed hundreds of glass failure analyses. These include over 70 tempered glass failures. In addition, for various manufacturers, I have performed qualification tests on numerous tempered glass parts (baking dishes, pot covers, toaster oven doors and tempered glass windows). I have been qualified to testify in trial as an expert in failure analysis at least forty times. A list of depositions and trials at which I have testified for during the last four years, along with my list of publications for the last ten years, is attached as Appendix B.

9. In the present action, I have applied my knowledge skill and experience with glass and glass failure analysis to evaluating the panoramic sunroofs in the Subject Vehicles, including an analysis of panoramic sunroofs in general, the science of glass used in the panoramic sunroofs, panoramic sunroof glass design, and the common defect in this design.

10. As described herein, based on my knowledge, skill and experience with glass and glass failure analysis, my review of documents in this case and my knowledge of panoramic sunroofs, it is my opinion that the panoramic sunroofs are defective and that this defect is common to all of the Subject vehicles.

11. My compensation for this case is $350.00/hour, and it is not dependent on the content of this report, any testimony I may give, or the outcome of this case.

12. In forming my opinions, I have relied upon my background and experience as set forth above, and these documents and items:

- Documents produced by Defendants Ford Motor Company
- Deposition transcripts of Chris Eikey, and attached exhibits.

III. BACKGROUND: PANORAMIC SUNROOFS

A. <u>Sunroofs in General</u>

13. A sunroof is an opening in an automobile roof that allows light into the vehicle. Many sunroofs can be opened to allow fresh air to enter the passenger compartment.

14. A panoramic sunroof, as opposed to a traditional or standard sunroof, is a larger opening in the automobile's rooftop that uses a tempered or laminated glass panel system. The glass panels cover a large portion of the roof area and can

consist of fixed and moveable glass panels. Traditional sunroofs have been only a fraction of the size of panoramic sunroofs.

B. <u>Design Factors in the Subject Vehicles' Panoramic Sunroofs</u>

15. Key factors for choosing glass for application in sunroofs include glass thickness, weight, size of glass, type of glass, percentage of frit cover and strength of glass.

16. Each panoramic sunroof assembly in the Subject Vehicles was designed and manufactured to include a factory-installed panoramic sunroof assembly, and is composed of one or two glass panels that fit within a stiff sunroof frame. Many assemblies include one moving panel which operates in a tilt and slide design. Each panel must be sealed to the frame assembly so that environmental forces like wind and precipitation do not enter the vehicle. Stress is applied to the glass panels in order to ensure a proper seal by pressing the glass against the seal.

17. [redacted] *See Eikey Dep.* at 56:22-25, 57:1-22. Further, each glass panel is larger than ½ square meter, and is an integral part of the vehicle unibody construction. *See Eikei Dep.* at p. 60:19-22.

18. The panoramic sunroof assemblies in the Subject Vehicles were manufactured by Webasto Donghee, Inalfa Roofing Systems, Vitroflex (Mexico), and Webasto De Mexico Irapuato.

19. An exemplar of the PSRs in the subject vehicles is shown below:

[redacted]

Figure #1: Ford illustration of installation of panoramic sunroof assembly in the Lincoln 2010 MKT.

20. As shown in Figure #2 below, each glass panel in the PSRs is affixed to the sunroof frame using a sealant or fasteners. The sunroof frame is affixed to the vehicle frame via fasteners. It is my understanding that these vehicles utilize a unibody construction which means that the entire body of the car handles and absorbs the loads and stresses applied to the vehicle.

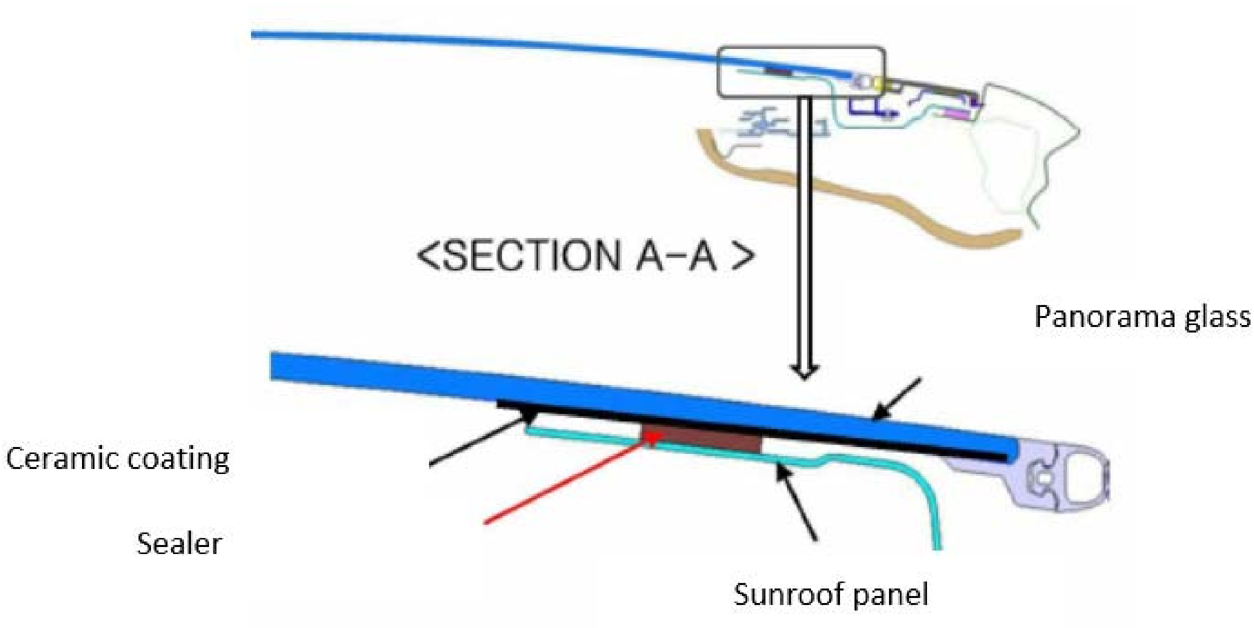


Figure #2: Exemplar diagram of an edge assembly of a panoramic sunroof.

C. Panoramic Sunroof Glass Design

21. Generally speaking, glass is made by fusing silica, soda, lime, and, depending on its intended use, other ingredients. Typically, glass is transparent and can be given different tints and strengths depending on its intended use.

22. When designing a product with glass, including sunroofs, engineers should understand the tensile stresses that will be applied to the glass, as well as the environment, and consequences of any failure. In most contexts, non-defective thermally tempered glass will not shatter under typical and foreseeable use within its expected environment.

23. There are multiple types of glass, including annealed glass, laminated glass, and safety or toughened glass, also known as tempered glass.

24. Annealed glass is glass that is essentially free of stress. These are typically used on consumer products such as glass bottles, drinking glasses, home windows, etc. When annealed glass fails, it breaks into large shards.

25. Laminated glass is another type of safety glass that consists of layers of annealed glass held together with a polymer layer. When laminated glass breaks, it breaks into large pieces that remain together due to the polymer interlayer sheet. Typical use is the windshield of a car, but it is also used in some furniture applications. In some circumstances, it is also used in sunroofs.

26. Thermally tempered glass is glass that is heat-treated to be stronger than annealed glass. When tempered glass fails it rapidly breaks into small, blocky pieces with sharp edges. Typical uses of tempered glass include car side windows, glass windows for liquid gauges, transparent lids for pots, and toaster oven doors.

27. There are two categories of thermally tempered glass:

a. <u>Fully Tempered Glass</u>: Glass that has a minimum of 10,000 psi compressive stress on both surfaces.

b. <u>Heat Strengthened Glass</u>: Glass that has from 4500 to 7500 psi compressive stress on both surfaces

28. The panoramic sunroofs in the Subject Vehicles utilize large glass panels composed of curved glass that has been fully tempered. It is helpful to think of the sunroof panel as a large glass membrane that can flex from various externally applied forces.

29. As part of the glass tempering process for sunroofs, the sunroof glass starts as an extremely flat piece of float glass (glass solidified on molten metal). The glass panels are shaped in a process called slumping by using a forming tool. This process does not produce an accurate shape. Consequently, as discussed below, there will be stresses produced when the sunroofs are affixed to the frame, which is problematic as these stresses reduce the tensile strength of the glass. This is important because, as described below, glass only fails in tension.

30. Thus, in the case of the subject panoramic sunroofs, which are made with thermally tempered glass, the sunroofs theoretically should be stronger and more resistant to thermal shock and mechanical damage than annealed glass. However, as described below, in customer descriptions of failures, it is shown that the thermally tempered glass in the Subject Vehicles is defective and unable to withstand the tensile force applied to the sunroof during normal operation of the vehicle.

IV. THE ESTABLISHED SCIENCE OF GLASS FAILURE ANALYSIS AND ENVIRONMENTAL CONSIDERATIONS

31. Glass failure analysis is the one known and proven technique used to determine the cause of failure of broken glass objects, and applies to sunroof glass.

32. Glass tempering was devised to put the surface of glass in compression. The compressive stresses must be overcome before the glass surface can be put into tension. For this reason, thermal temper processes were developed. Thermal tempering is the process of adding surface compression to glass, making it stronger.

33. Referring to Figure #3 below, glass only fails in tension, so one needs to understand the stress state of the glass at the time of failure.

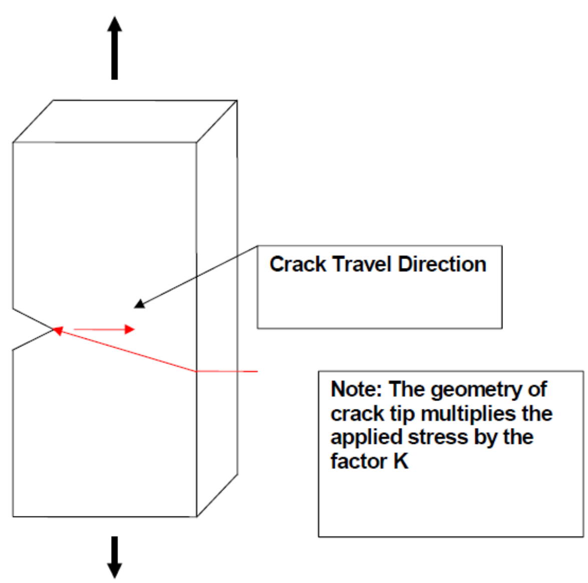


Figure #3: Illustration demonstrating the only failure mode of glass (i.e. glass only fails in tension).

34. Glass failure analysis began in the early twentieth century. Alan Arnold Griffith, a pioneer in the study of glass failure analysis, along with other glass experts, developed the equations of elasticity used to describe quantitatively the fracture of brittle solids, such as glass. In the same time period, Wallner determined how to interpret the markings on glass fracture surfaces to locate the "origin" of the glass failure. More recently, several texts have been written that summarize the necessary techniques used by scientists and engineers to perform glass failure analysis and determine the cause of the failure. Lay persons, automotive technicians, and even engineers, without proper training cannot reliably determine the reason tempered glass failed.[1]

35. Generally, two steps can be taken to perform glass failure analysis, including:

a. Glass Failure Analysis Stage #1: When possible, assemble the glass pieces to determine the overall crack pattern. Often the crack pattern guides one to the approximate location of the origin. In this case (i.e., tempered glass) the crack pattern

[1] *See* Failure Analysis of Brittle Materials, V. D. Frechette, American Ceramic Society (1990) ISBN 0-944904-30-0; Glass Engineering Handbook, E. B. Shand, Mc Graw-Hill Book Company, Inc (1958); Fractography of Glass, Edited by Bradt & Tressler, Plenum Press (1994); Fractography of Glasses and Ceramics II, Ceramic Transactions, 17, Varner and Frechette, American Ceramic Society (1991); Fractography of Ceramics and Glasses, NIST Publication 960-16.

initiates at one point and radiates outward (similar to the spokes on a bicycle wheel).

b. Glass Failure Analysis Stage #2: Stage two is to use markings on the fracture surface (the surfaces created during failure) to trace the cracks back to the "failure origin" and then examine the origin microscopically to determine what led to the failure. Normally Wallner lines (defined below) on the fracture surface are used for this purpose.

36. Wallner lines are sets of curved marks that all emanate from the origin. By examining the direction of the curvature of the lines, one can trace backward along the fracture surface to the origin.

37. Wallner lines are formed as a result of an interaction of the moving crack front with sound waves reflecting off artifacts of the fracture surface. Figure #4 illustrates how one class of Wallner lines is formed.

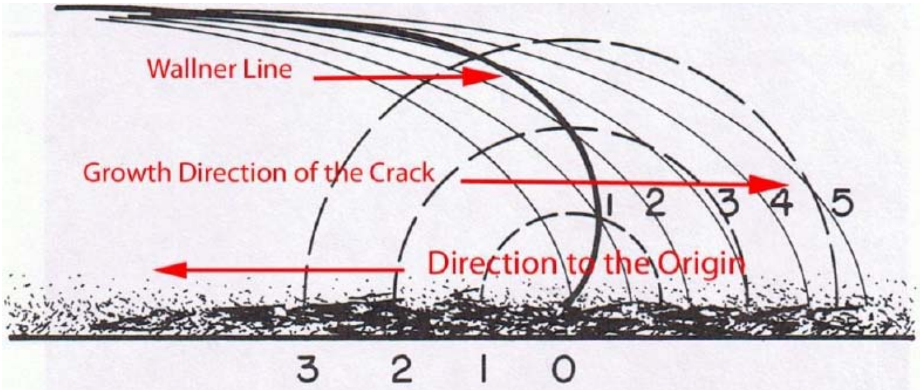
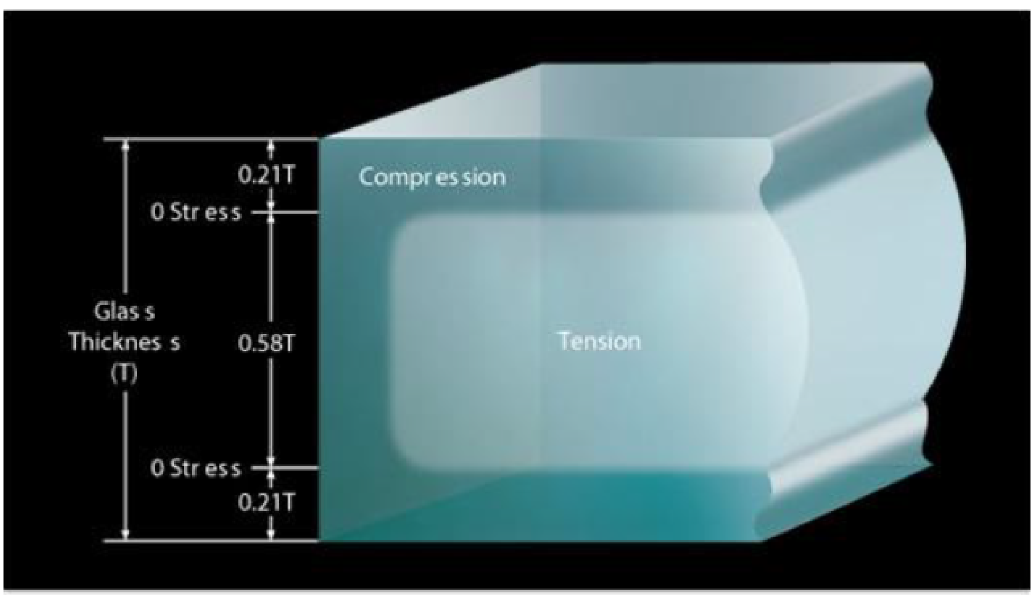


Fig. 2–9. Stages in the production of a secondary Wallner line, caused by mist hackle roughness at the lower edge. Numbered arcs in the sketch show positions of the crack front at successive times; dashed lines show corresponding positions of the (faster) elastic pulse generated at one of the roughness details. The Wallner line is the locus of their intersection.

<u>Figure #4</u>: Formation of secondary Wallner lines. In this case the sound waves associated with cracking interact with defects along the edge of the crack. These sound waves reflect back and interact with the crack front and form the Wallner lines. In this case, the crack is moving from left to right. One uses the curvature of the Wallner lines to determine the crack travel direction.

38. The stress profile of tempered glass is similar to the stress profile of glass used for the panoramic sunroofs in the Subject Vehicles (See Figures #5 and #6).



<u>Figure #5</u>: Simplified stress profile of tempered glass.

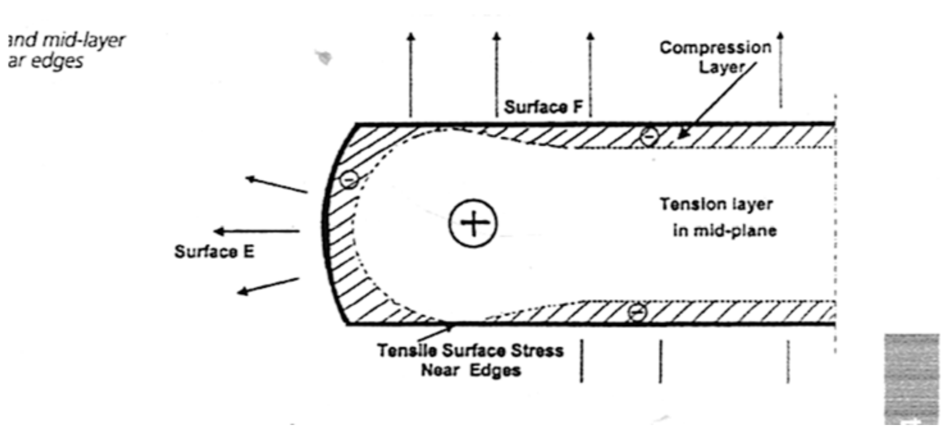


Figure #6: Simplified stress profile of tempered glass near the edge. Because of edge affects the thickness of the protective compression layer goes to near zero near the edge. Thus, one cannot assume adequate protection from tempering near the edge of the part.

39. With panoramic sunroofs, approximately the outer 1/5th of the surface is in compression, and the center core is in tension. In order to break this glass by bending, the compressive stresses at the surface must be overcome. Alternately, if a crack (i.e. damage) penetrates the compressive layer, the interior tensile stresses in the glass drives the failure, and the glass self-destructs. Any mechanical process that leads to penetration of the compressive layer will cause the glass to fail completely.

40. Penetration of the compressive layer can be either instantaneous or it can be "progressive" (i.e., the crack grows over time until it has penetrated into the tensile core). Progressive failures are the result of additional tensile stresses, meaning they are applied after the initial damage has occurred.

41. If surface damage leads to immediate failure, there will be a one-time damage event at origin that starts on the outer surface of the glass and penetrates into the tensile stress region of the glass interior. Applied tensile stresses applied to tempered glass lower the thickness of the compressive layer and make it more vulnerable to immediate failure.

42. [redacted]

43. Here, Ford admitted that its own investigations of fractured laminated PSRs showed that the fractures were caused by impacts from unknown objects, such as small road debris or stones. *Eikey Dep.* at 102-103. This assessment would apply equally to tempered glass because both tempered and laminated glass are in the same environment and all glass, whether tempered or laminated, fails in tension. Ford

indicated that damage from external impacts to the PSRs is not warrantable because the impact and resulting fracture was caused by an external force. However, this is an affront to basic glass science as Ford's investigations actually confirm that a single impact to the PSRs in the Subject vehicles can damage the sunroof, and such damage can and will ultimately lead to catastrophic failure of the glass because of the defect in the glass, whether it is instantaneous or progressive. In other words, once the impact damage occurs, the wheels of destruction are set in motion and basic glass science dictates that the crack will ultimately penetrate the outer 1/5th compressive layer of the PSR into the tensile core area in the PSR, which will cause the glass to self-destruct. And, as mentioned above, if a one-time damage event, such as a crack from road debris or a stone, penetrates the compressive layer, the interior <u>tensile stresses in the glass drives the failure, and the glass will self-destruct</u>.

44. Further, as discussed in greater detail below, environmental and tensile stresses common to the Subject Vehicles (such as road vibrations and bumps, changes in pressure from opening and closing the window, thermal shock from heating and cooling, etc.) can cause the PSR to spontaneously self-destruct as a result of their design defect. They can also contribute further to a later failure from a one-time damage event, such as road debris, resulting in catastrophic failure of the PSRs.

Notably, this defect does not exist in steel roofs, which are able to withstand one-time damage events from small debris.

45. Below, I have included multiple examples of glass surface damage to illustrate what causes glass failure. These examples are relevant to my evaluation of the defective sunroof glass because they represent the standard failure analysis procedure that applies to all glass failures because all glass fails only in tension, as described herein.

46. The following is a photograph of a tempered soda lime glass toaster oven door panel that was broken using a spring loaded center punch that created a crack that penetrated the compressive layer and caused the glass to self-destruct. This panel was covered with clear tape on the back side, to hold the pieces together, and it was then center punched at the origin. The cracking radiated from the origin, and at the origin is a tell-tale "butterfly". The failure analysis follows the radiating cracks back to the origin; the pieces at the origin are removed to expose the fracture surface, and the origin is analyzed microscopically to determine the cause.

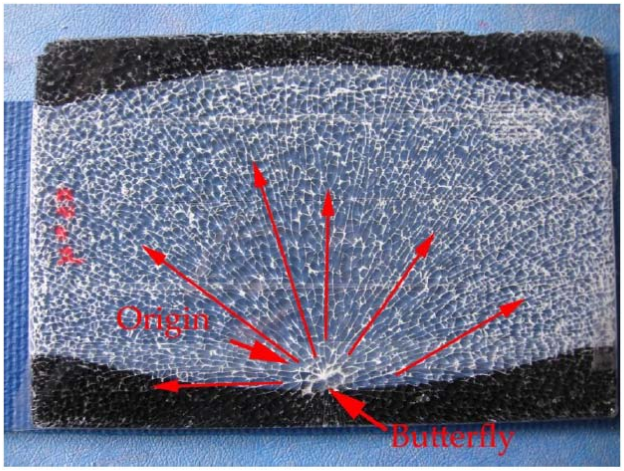


Figure #7: Demonstration of an overall crack pattern. The cracking radiates from the origin at a speed of 3600 MPH, and the glass panel breaks into a large number of small pieces.

47. The following is a photograph of a tempered soda lime glass pot lid. This failure was initiated where a steel cup washer was rubbing on the underside of the tempered glass pot lid. Over time the rubbing created a progressive flaw in the glass that penetrated the outer compression layer into the tensile region and the glass cover self-destructed. This is not an impact failure.

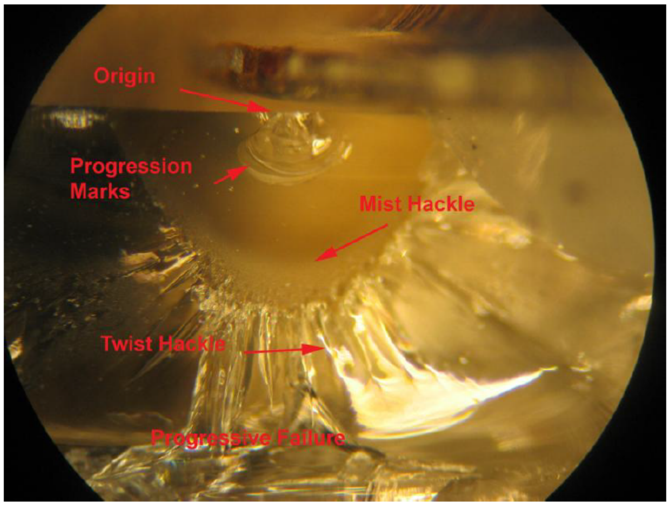


Figure #8: Photomicrograph of a known progressive tempered glass failure.

48. The following is a photograph of a fully tempered glass panel that was impacted with a rock that damaged the surface, but did not penetrate the compressive layer. Thus, it did not cause a failure.

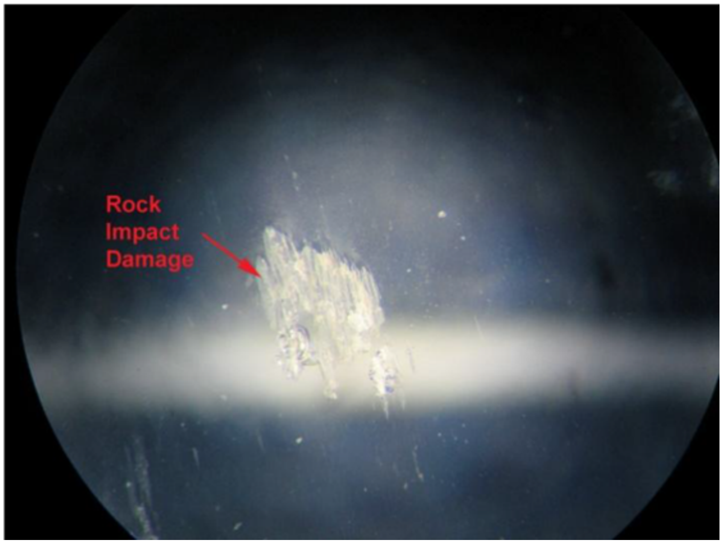


Figure #9: A fully tempered glass panel was impacted with a rock, but the impact did not cause failure. The surface damage is abrasive in nature.

49. The following is a photograph of the glass panel in Figure #9, which was later put under bending load to failure. The failure originated at the abrasion shown in Figure #9. The origin is shown above. This failure is not progressive in nature. However, it demonstrates that post-damage stresses can drive a defect to failure.

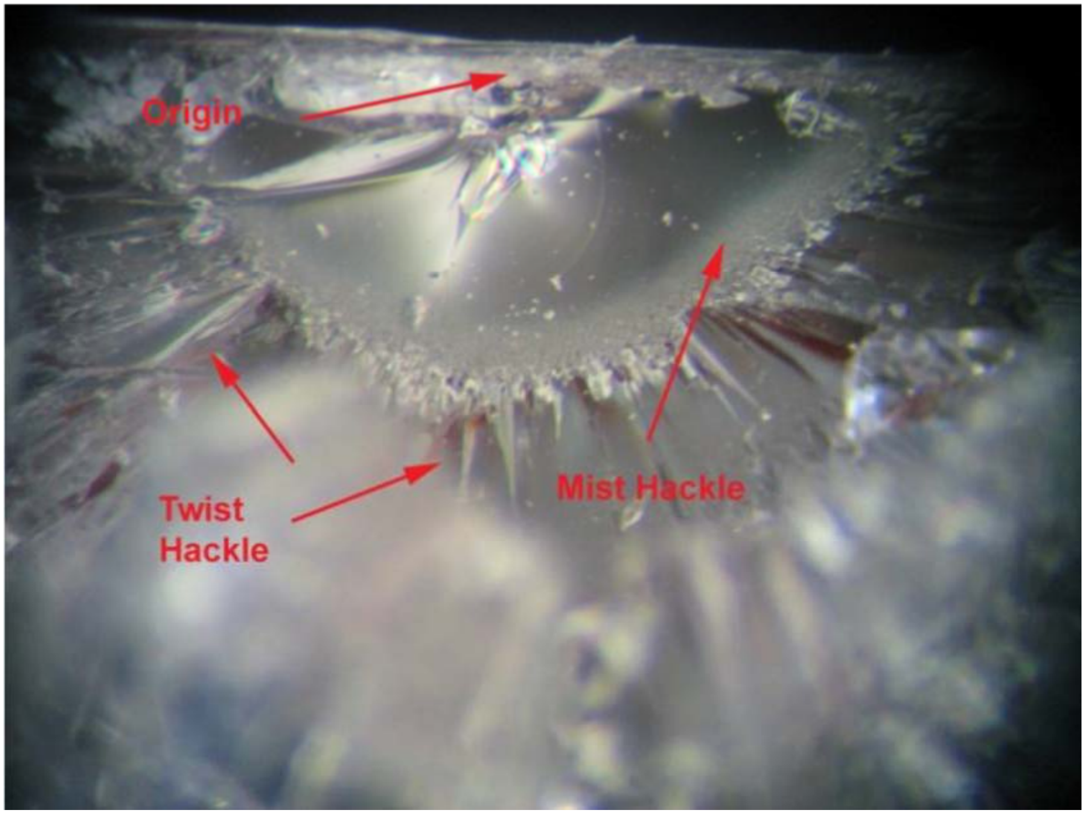


Figure #10: The damaged panel above, also shown in Figure #9 (Mag. 40X).

50. Figures #11 & 12 are photomicrographs, which demonstrate that the glass in contact with the frit is not fully tempered.

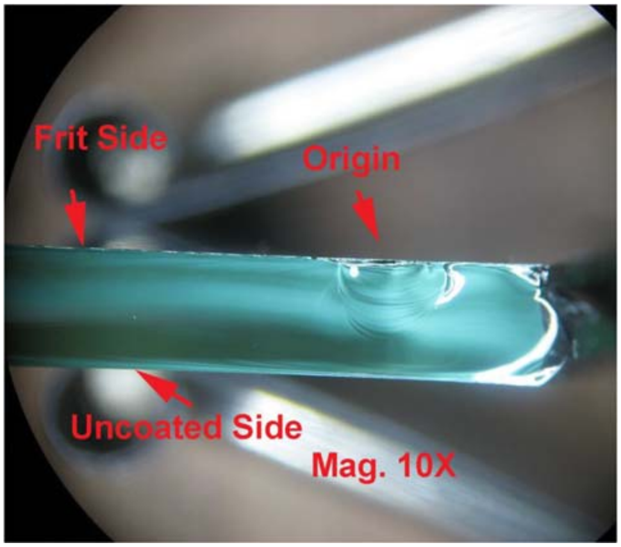


Figure #11:

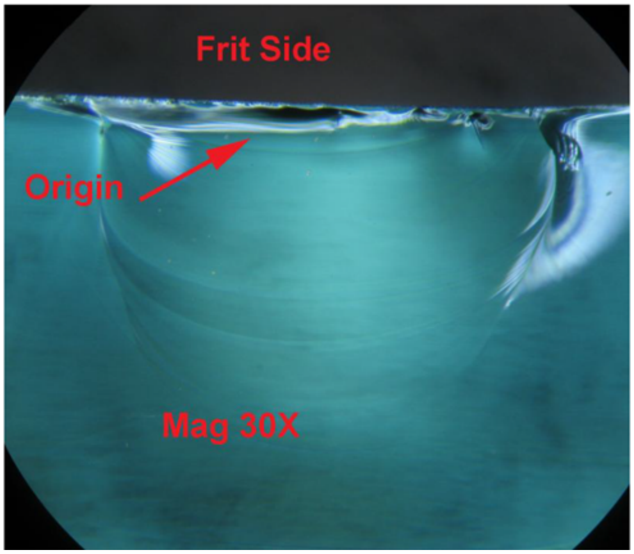


Figure #12:

<u>Figures #11 and #12</u>: Photomicrographs above showing a failure from thermal shock that initiated under the frit in tempered glass. This glass without the frit would easily pass thermal shock testing.

51. [redacted]

[redacted]

See Eikey Dep. at Ex. 38.

52. Collectively, these figures illustrate the procedures used to determine the cause of glass failure, which are methods generally accepted in the scientific community, and which have been applied for more than a century.

V. SUMMARY OF ADDITIVE ENVIRONMENTAL FACTORS (NON HIGHWAY FAILURES) RELEVANT TO PSR GLASS FAILURES.

53. In addition to the defect in the glass design and materials, it is important to consider the environment and tensile stresses to which it will be exposed during normal use. When glass is used in sunroofs, there are numerous sources of tensile stresses applied to the glass, all of which are common to each of the Subject Vehicles, which can initiate a later failure and are also reasonably foreseeable, including:

a. Mounting mismatched glass to a stiff sunroof frame;

b. Affixing the frame to the vehicle;

c. Clamping pressure applied to the sunroof to close it and keep it attached to the vehicle;

d. Thermal shock from heating and cooling;

e. Flexing of the glass during driving;

f. Road vibrations and bumps;

g. Changes in pressure, e.g., closing and opening windows and doors and pressures created from driving;

h. Reduced compressive stress at the panel edges; and

i. Minor and foreseeable minor impacts (e.g., hail or gravel or pebbles kicked up off the road).

j. Frit coating that weakens the glass. (*See Eikey Dep.* at Ex. 45)

VI. SUBJECT VEHICLE PANORAMIC SUNROOF FAILURES

54. It appears that many of the panoramic sunroofs in the Subject Vehicles have already shattered.

55. Numerous customer complaints on NHTSA demonstrate that a significant number of sunroof breakage events occurred in the Subject Vehicles,

including while the Subject Vehicles were stationary or in a low-speed situation. *See Eikey Dep.* at Ex. 54.

56. [redacted]

a. [redacted]

b. [redacted]

c. [redacted]

57. [redacted]

a. [redacted]

b. [redacted]

VII. ALL PANORAMIC SUNROOFS IN THE SUBJECT VEHICLES SUFFER FROM A COMMON DEFECT

58. It is my considered opinion that the panoramic sunroofs in the Subject Vehicles share a uniform defect, as described herein.

59. The glass failure is the result of defective design, which is further impacted by normal and anticipated environmental stresses, as described herein.

60. In addition to spontaneous failure, PSR sunroofs can, have, and will frequently shatter due to minor impacts combined with the other tensile stresses applied to the glass during normal use. These additional stresses will cause the initial failure to grow and cause catastrophic failure. The initial damage grows to the point that it penetrates the compressive layer and penetrates into the tensile region, which will cause the glass to self-destruct. Basically, the initial damage grows until it penetrates the compressive layer and into the tensile region, and the glass panel self-destructs. In other words, while an initial, external impact may not immediately cause catastrophic failure, the wheels of destruction are set in motion and basic glass science dictates that the glass will ultimately self-destruct.

61. Because stresses are additive, for glass that has surface compression, the residual surface compressive stresses need to be overcome before the surface can

be put in tension. Once the applied tensile stress overcomes the compressive stresses (and the normal actual glass breaking stress) the glass fails catastrophically.

62. The glass used in the Subject Vehicles' panoramic sunroofs needs to be able to withstand tensile stresses above 10,000 psi in order to be considered tempered safety glass. However, the glass used in Subject Vehicles' sunroofs is not performing to this standard and fail at much lower tensile loads than the 10,000 psi standard. These stresses are a result of the PSR assembly and reasonably foreseeable use.

63. Further, the Subject Vehicles utilize glass panels that are 4.8-5 mm thick. This is not sufficient thickness for the size of the glass panels used in the PSRs. Increasing glass size without increasing glass thickness makes the glass more vulnerable under applied loads. Similarly, the thickness of the protective compression layer decreases with glass thickness.

64. In addition, the glass panels in the PSRs also utilize a ceramic print around the outer border of each panel. Ceramic print is a mixture of ceramic frit and polymer binders that are painted on the glass surface and baked (and is sometimes referred to simply as frit or enamel). The ceramic print covers a significant portion of the glass area in Subject Vehicles. The purpose of the ceramic print is to strengthen the adhesion of the urethane sealant that affixes the glass to the sunroof

frame, to prevent the urethane's decomposition from ultraviolet rays, and for aesthetic reasons. However, the frit interferes with the temper process and weakens the tempered glass it is in contact with.

65. Given the size, thinness, curvature, ceramic print, and attachment to the unibody frame, the panoramic sunroof glass in the Subject Vehicles is weakened and not capable of withstanding the tensile stresses one would reasonably anticipate, making the glass defective in that it is substantially likely to shatter and not reasonably fit for its intended use and environment. In other words, the panoramic sunroofs in Subject Vehicles will experience glass shattering in connection with the tensile stresses discussed herein, even though those forces are not capable of shattering non-defective sunroofs. It is important to note the PSR is replacing a steel roof that is completely reliable.

66. A Fully tempered PSR is very difficult to break; therefore, failure from direct impact is unlikely.

Dated: 2/22/19

Thomas L Read

Thomas L. Read, PhD

REGISTERED PROFESSIONAL ENGINEER ★ STATE OF CALIFORNIA ★
MANUFACTURING
THOMAS LAURENCE READ
No. MF 2174
Exp. 2020

APPENDIX A

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tread@sonic.net www.readconsulting.com

PROFESSIONAL LICENSE

Registered Professional Engineer: Certificate No. MFOO2174, State of California

SUMMARY OF EXPERTISE

1. Over 40 years of experience as a consultant to attorneys in glass, metallurgy, accident reconstruction, OSHA worker safety, products liability, intellectual property, factory safety and other litigation. This includes numerous depositions and court appearances.
2. 40 years of manufacturing experience in the glass and electronics industry doing processing, process and product introduction, equipment design and build, glass and metal grinding, forming and polishing, part design, machine safety, machine design, quality control, and materials engineering.

ACCIDENT RECONSTRUCTION

User and Worker safety, Product Liability and equipment design (Includes device safety, factory safety and machine guards)
Failure Analysis (Includes both materials and design)

- *Glass Damage & Failures:* Doors, Bottles , Laminated Safety Glass, Windows, Windshields, Wire Glass etc
- *Manufacturing Defects:* Sealing Failures , Any manufactured Item. Tubing failures (metal glass and plastics).
- *Metallurgical Failures:* Implants, Pipes, Ladders, Bolts, Heaters, Welds, Gears, Chairs, Prosthetics, Plumbing, etc
- *Corrosion Failures:* Galvanic, General, Stress Corrosion; this includes materials selection and environment
- *Ceramic and Porcelain Failures:* Grinding Wheels, Cutoff Blades and Structural Ceramics (Toilets etc.)
- *Polymer (Plastic) Degradation and Failures:* Piping, Ladders, Joints, Seals, Packaging, Chairs, Medical Devices, Implants,
- *Wood Failures:* Chairs, Ladders, Stairs, Window Leaks etc (Includes deterioration from rot).

Manufacturing Expertise: Includes Patents, Tooling, Processing Equipment, Product Design, Factory Safety (Machine Guards), Quality Control, Quality Verification, Reverse Engineering and Factory Procedures

PROFESSIONAL EXPERIENCE

1975 - Present	*Engineering Consultant* in private practice with attorneys and insurance adjusters. Litigation-related practice includes plaintiff and defense clients in approximately equal numbers. Included are numerous depositions and trial appearances.
2001- 2002	Senior Metallurgical Engineer and Safety Engineer Rheodyne, Inc. Rohnert Park, CA
1993 - 2001	Chief Metallurgist Komag Materials Technology Inc., Santa Rosa, California
1988 - 1993	*Senior Thin Film Project Engineer. Thin film Coating Equipment Design* Deposition Sciences Inc., Santa Rosa, California
1984 - 1988	*Thin Film Circuit Engineer, Safety Engineer* and *Reliability Engineer* Microwave Technology Inc., Fremont, California
1975 - 1984	*Project Engineer, Safety Engineer and Project Manager* Hewlett Packard Co., Santa Rosa, California
1974 - 1975	*Senior Project Engineer* Optical Coating Laboratories Inc., Santa Rosa, California
1972 - 1974	*Senior Process Engineer* Corning Glass Works, Coming, New York. Included glass finishing process development and glass failure analysis.
1969 -1972	*Engineering Consultant* Failure Analysis Associates, Stanford, California. Aided engineers with failure analysis.

ACADEMIC DEGREES

1. Stanford University, Ph.D*. Materials Science and Engineering*, 1972
2. Stanford University, MS *Materials Science*, 1969
3. University of Pennsylvania, BS *Metallurgical Engineering*, 1965
4. Diploma, Tercer Curso Panamericano de Metalurgia Nuclear, Buenos Aires, Argentina, 1968

Additional Skills

Fluent in written and spoken Spanish

APPENDIX B

Thomas L. Read, PhD.
Read Consulting LLC
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Santa Rosa, CA 95403

DEPOSITIONS

1. Jones v Steinfelds et al December 3, 2008, Santa Rosa, CA
2. NAZ LLC v. Philips Healthcare, November 13, 2018, New Orleans, LA
3. Kondash v Kia Motor America, March 6, 2018, San Francisco, CA
4. Wiley v. Dairy Farmers of America, February 27, 2018. Santa Rosa, CA
5. Gabarini v. DS Services of America, February 7, 2018, Fort Lauderdale, FL.
6. Harkey et al. v.General Electric Corp. San Francisco, CA, February1, 2018.
7. Gabarini v DS Service of Ameruica, January 29, 2018, Fort Lauderdale, FL
8. Risley v. Circus Circus, December 7, 2017, Santa Rosa, CA
9. Appel v D. F. Daniels Corp., Glendale, CA August 23, 2017
10. Fama et al. v Hyundai San Francisco, CA July 19, 2017.
11. Bankers v. Kohler, Woodland Hills CA, APRIL 28, 2016
12. Harkey et al. v.General Electric Corp. San Francisco, CA, November 11, 2015.
13. Lexington Insurance v Probuilt Professional Products, Walnut Creek CA, September 30, 2015.
14. South City Lights V City View Marabella, Walnut Creek, CA, July 30, 2015.
15. Manning v Tower 23, February 6, 2015San Diego, CA
16. Gexpro v. International Line Builders, Los Angeles, CA, August 26, 2014
17. Shamsnia v Allstate Insurance, August 21, 2013, El Segundo, CA.
18. Guiterrez v Landavazzo, August 12, 2013, Martinez, CA
19. Gorham v Silaohet-Tone, August 1, 2013, San Francisco, CA
20. Sandoval v Eagle Pizza/Hollman, June 20, 2013, Oakland, CA.
21. Myers v. The Horseshoe Tavern, January 4, 2013, Oakland, CA.
22. Byrd v. Caranica, October 5, 2012, Santa Rosa, CA
23. Zimmerman v. Thomas and Associates, August 30, 2012, Fresno, CA
24. Eddie Horner v. Paneltech et al., May 30, 2012, Santa Rosa, CA.
25. DeLong v Raley's, March 2, 2012, 402 Hearing, Sacramento, CA
26. Ghiaradelli v. Duhig, December 22, 2011, San Francisco, CA
27. Battaglini v. Bravo Bottling LLC, November 29, 2011, Santa Rosa, CA
28. Rich v. State of CA, June,10, 2011, Sacramento, CA
29. Monterey Mechanical v. Goodall Rubber Co. June 5 2011, San Francisco, CA.
30. D. Rae DeLong v Raley's, May 16, 2011, Sacramenta, CA
31. Casey v. Treehan, January 27, 2011, Sacramento, CA

Trials and Court Appearances

1. Wright v. Evergreen December 5 &6, 2018, Stockton, CA
2. Gabarini v. DS Services of Ameruica, February 21, 2018, Fort Lauderdale, FL.
3. Bankers v. Kohler, Ventura CA, December 6, 2016
4. Malvaes v. Constellation Brands, Miami, FL November 5, 2015
5. Zimmerman v. Thomas, October 2, 2012, Fresno, CA
6. Eddie Horner v. Paneltech et al., September 21 & 24, 2012, Sacramento, CA.
7. Geddie v. Hochmayr, April 20, 2012, Houston TX
8. DeLong v Raley's, March 21, 2012, Sacramento, CA